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Small and Synoptic Scale Phenomena in AIRS Retrievals

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Greenbelt MD
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A Phased Approach Discussed Today

- Search for local unusual geophysical situation for retrieval reality check.
  - Motivated by a search for retrieval anomalies.

- Highlight some interesting global features that further support the claim on reality.

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Part I: Smaller-scale features in AIRS retrievals

- **Motivation**: Search for 'problem' retrieval

- **Approach**: Use candidate anomalous features as diagnostics
  - Vertically 'unresolvable' small-scale features
    - *Temperature inversions*
  - Dynamically unstable temperatures
    - *Superadiabatic lapse rates*
  - 'Funny' situations
    - *SST much higher than overlying air*

- **Conclusion**: 'Anomalies' are climatologically realistic phenomena
  - I'll show several examples today.

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Near-surface Temperature Inversions

Summarizing from 21 August NetMeeting

- In the correct locations
  - Subtropical, western sides of continents.
  - Often adjacent to stratus regions (where retrieval has problems…)
- Confined to lowest levels, again consistent with climatology.
- Showed a case at August NetMeeting where Vis/NIR image contains few or no clouds.
  - Examined in more detail today.

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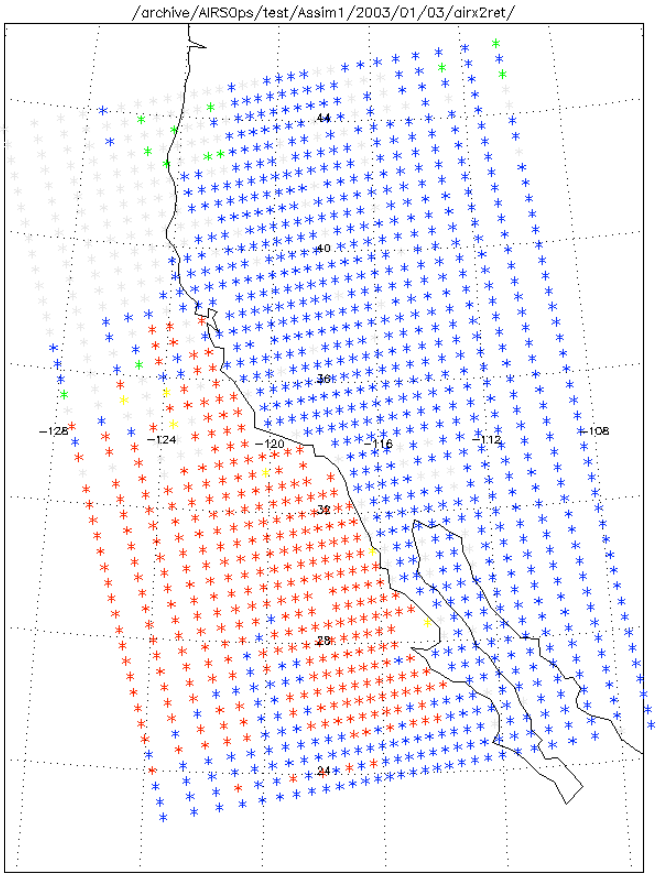
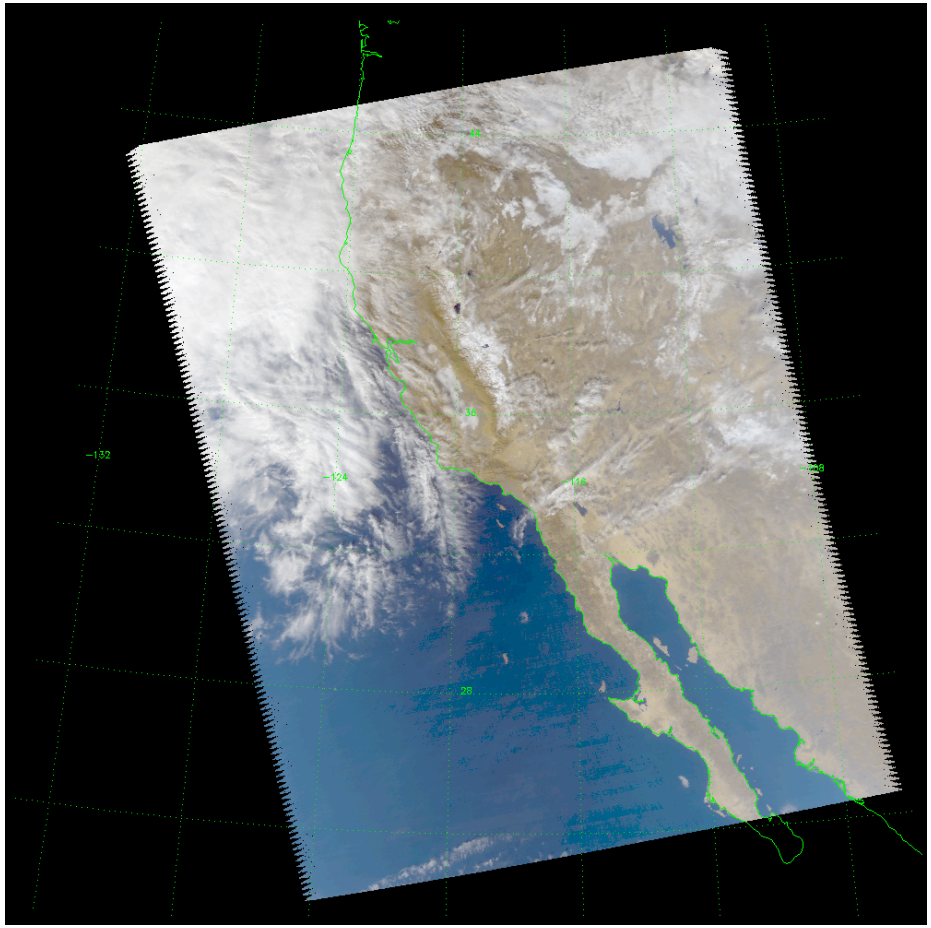
From August NetMeeting

Left: 'Good' (SST) inversions in red
Right: Vis/NIR image

Granule 210, 3 January 2003





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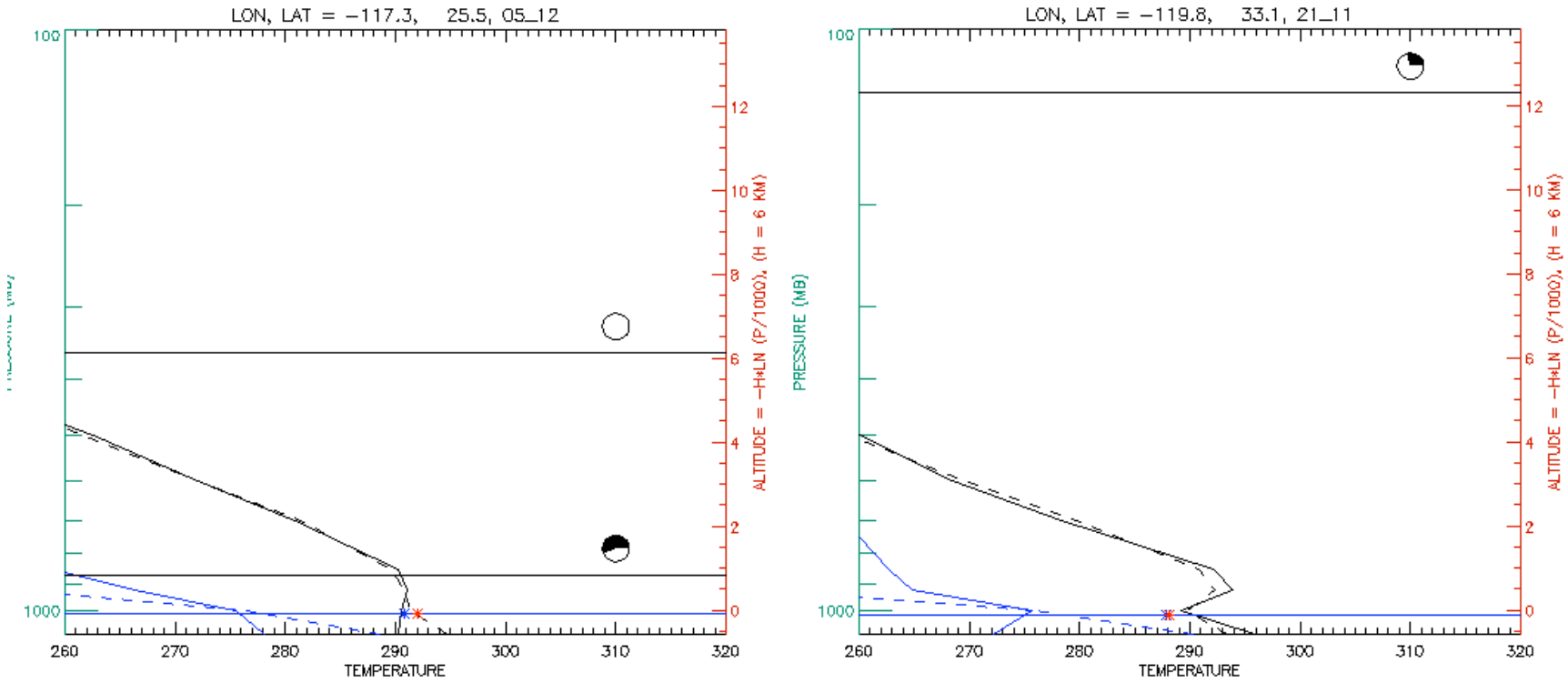
Good Agreement with ECMWF in Temperature

Black = T, Blue = T_{dew} Smooth: AIRS, Dashed: ECMWF

Blue Asterisk = AIRS SST, Red Asterisk = ECMWF SST



NOTE: T agrees well, humidity does not!

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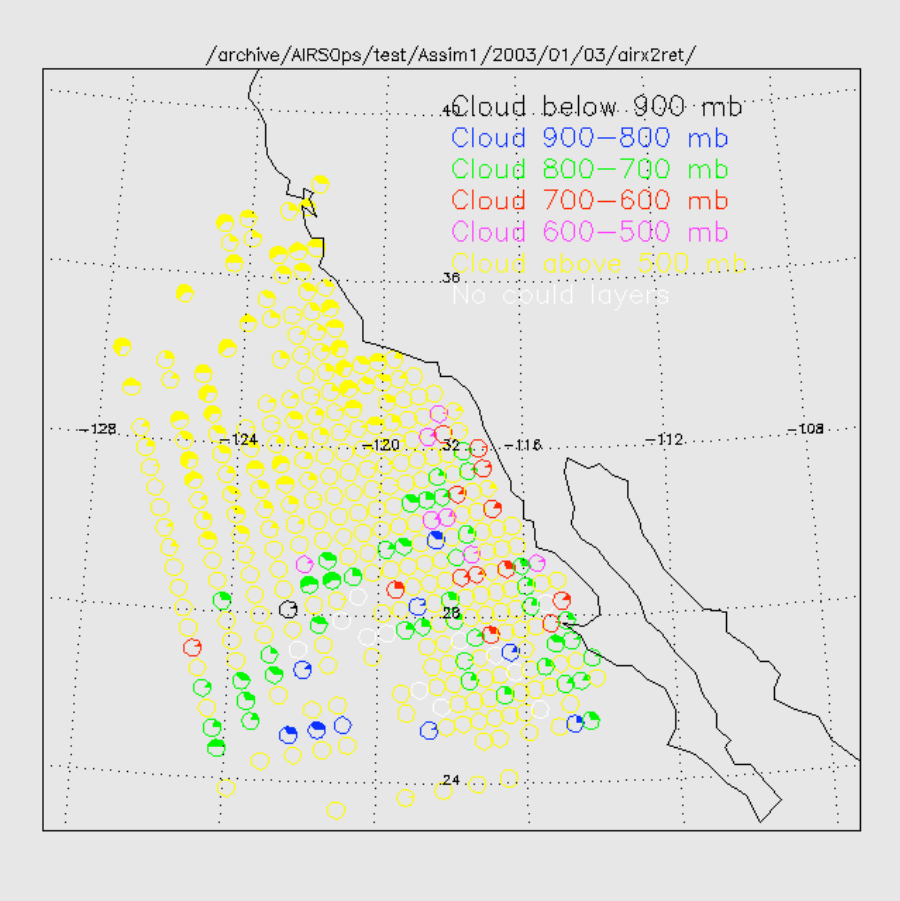
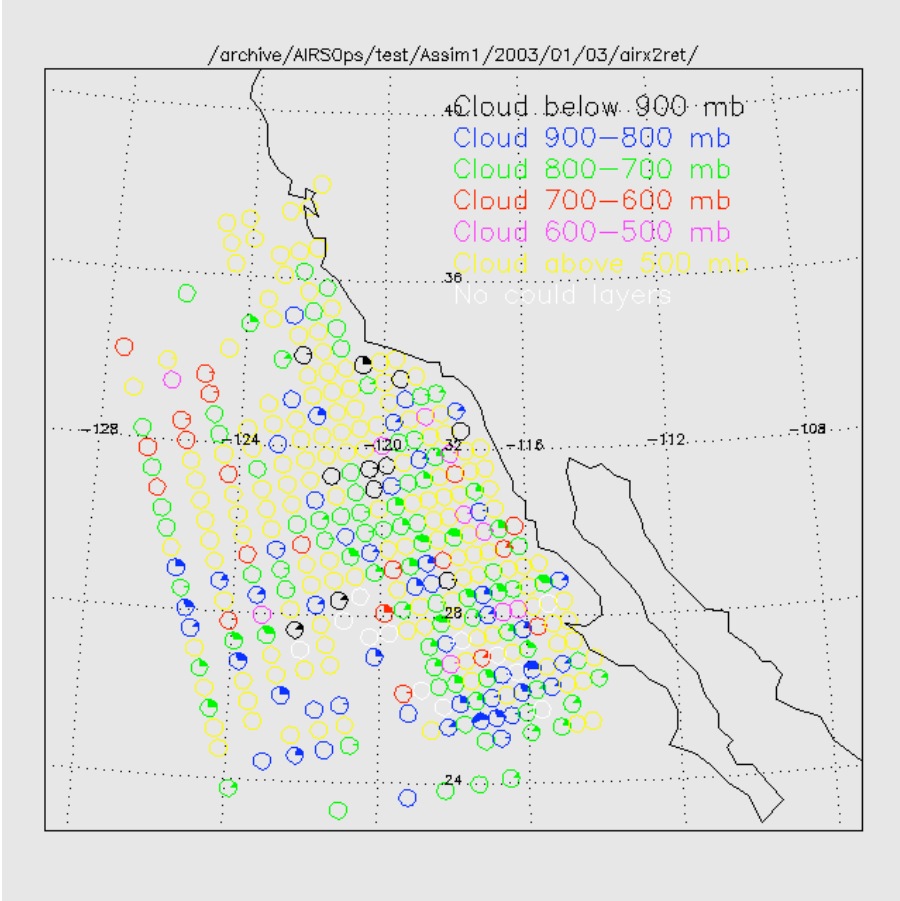
From August: Retrieved Cloud Properties at Inversions

Left: Upper cloud layer Right: Lower cloud layer

Circle fill is cloud fraction





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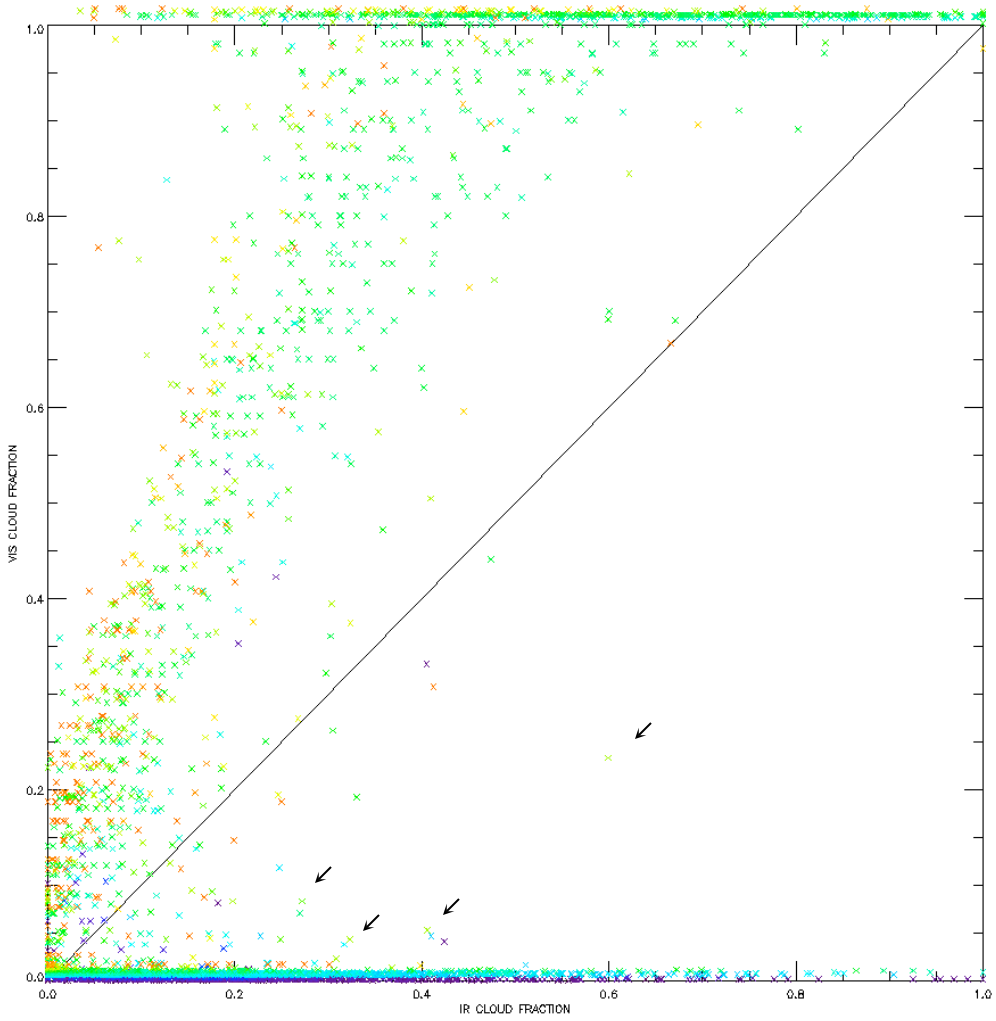
Cross-comparing Vis/NIR and IR cloud fractions

Retrieved IR vs. Vis-NIR fractions AT AIRS RESOLUTION



Colors show highest IR cloud
Blue/black: 1 km
Green: 3-5 km
Red: High

å

- Only a handful of points near bottom are suspect (arrows). All others agree within error estimates, or the conservative overestimate by Vis-NIR.

- Expect Vis/NIR to be higher. Seen also in TOVS.

- The pileup at top of figure is not fully understood (THOUGH ALL AGREE WITHIN RETRIEVAL ERRORS EST.)

Conclusions About Temperature Inversions

- Sometimes they are real
  - ECMWF agrees with retrieved T; q is not so obvious.
  - Vis/NIR and retrieved cloud fractions agree within estimated errors and conservative Vis/NIR estimate.
    - Exception is a handful of
- Sometimes they aren't
  - Seen most often off South America. Maybe due to climatology.
  - Flagged by SST diffs.
  - May be internal diagnostics, such as inversion depth.
- Next Steps
  - Examine the problem cases
  - Need to examine humidity in more detail.

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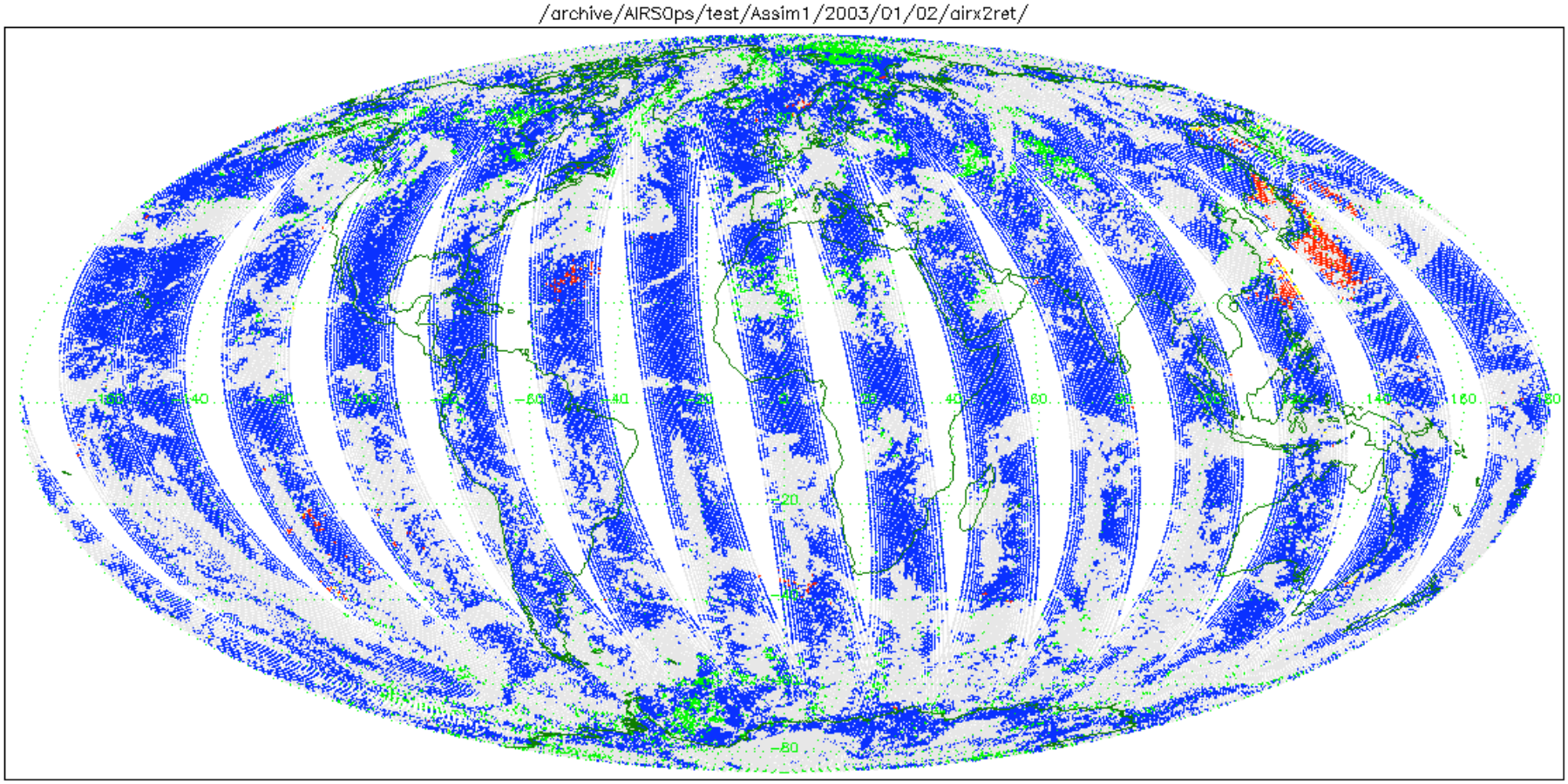
Superadiabatic Lapse Rates

Red/Yellow = Superadiabatic; Yellow = SST disagrees w/NCEP



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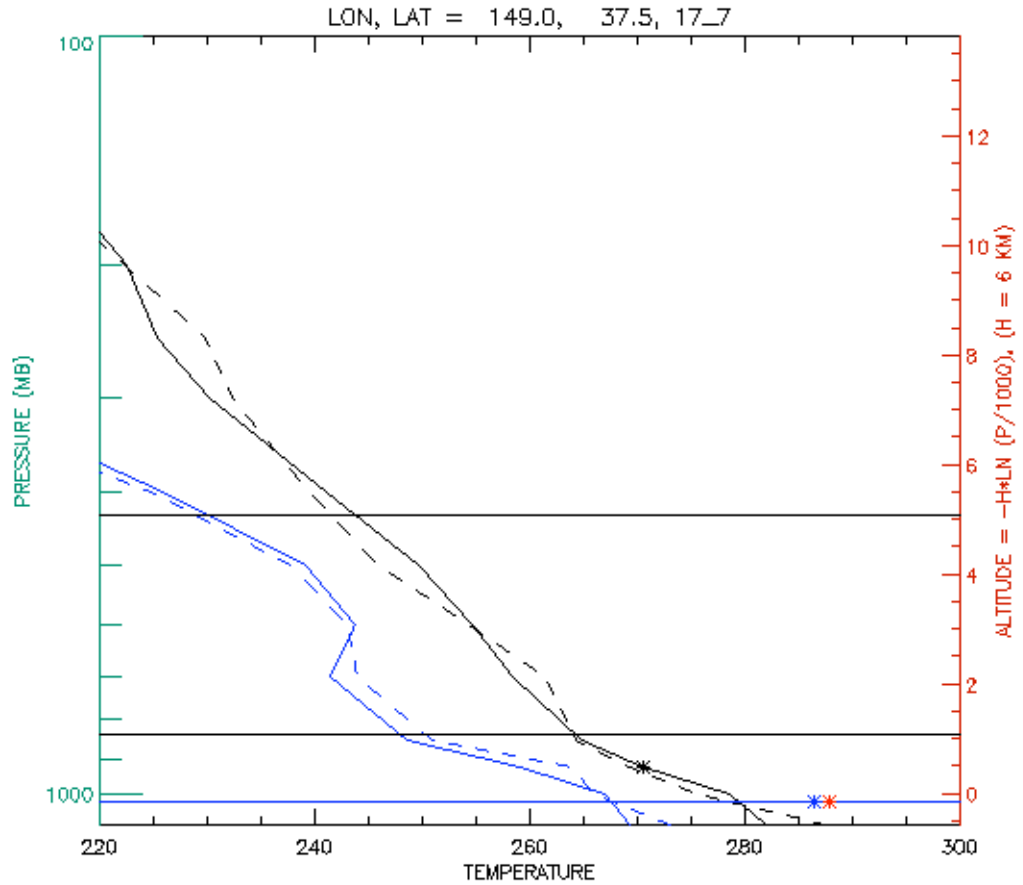
Is it real? ECMWF temps *almost* agree with retrieval

NOTE: Unlike with inversions, good agreement in water



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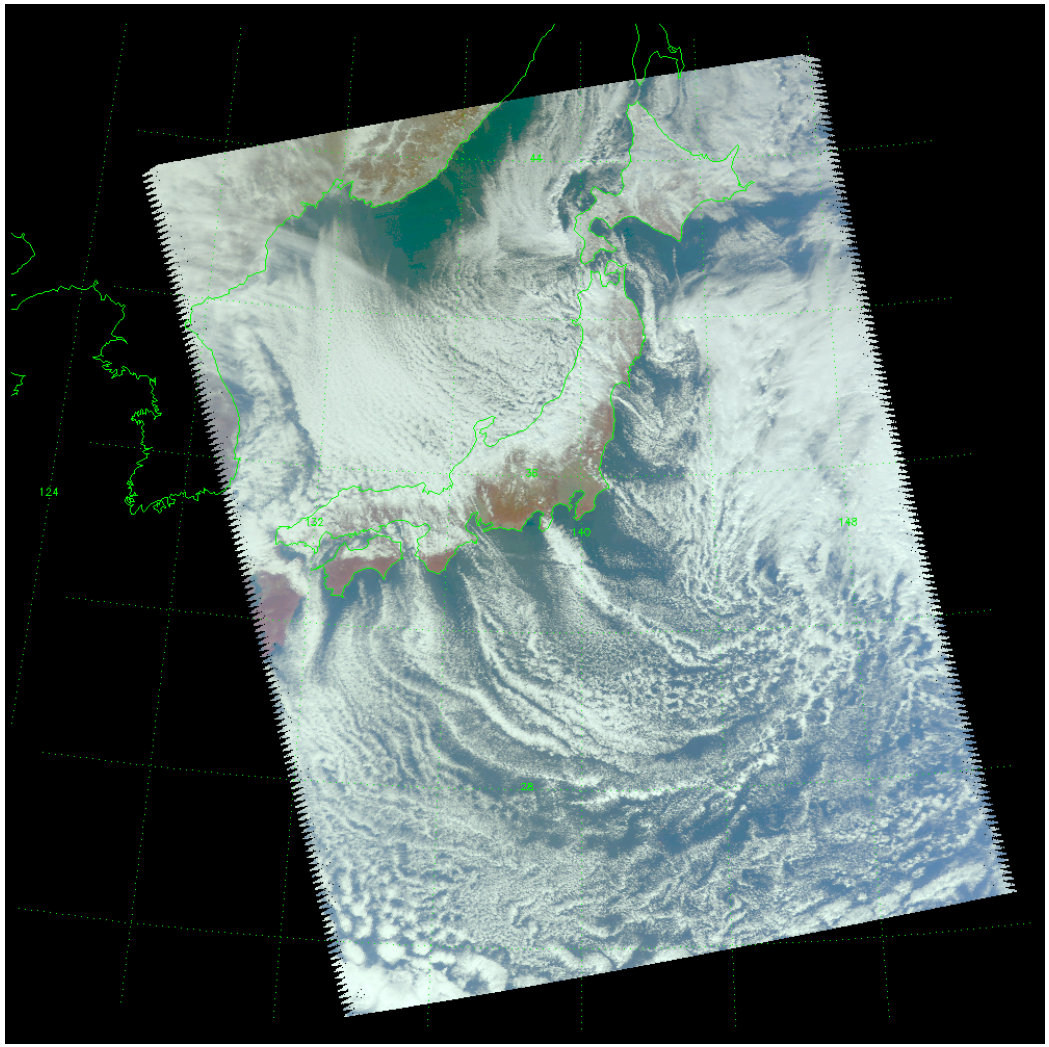
January 1, 2003, The Synoptic Situation: COLD air from Siberia over warm ocean



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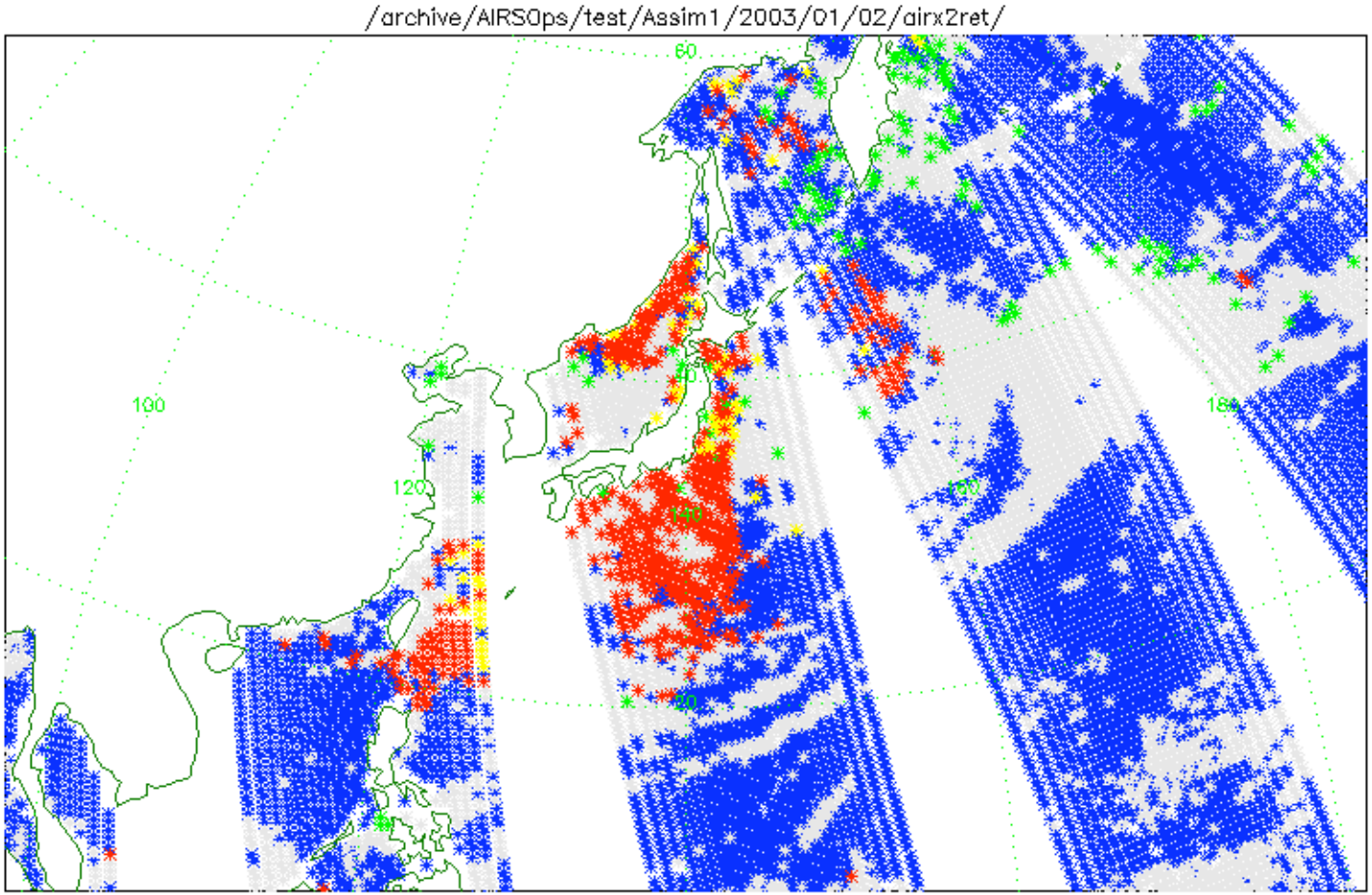
A Cold Air Outbreak over East Asia, 1/2/03

Red=Superadiabatic; Yellow=S.A & SST disagrees w/NCEP
Green=Regression; Blue=Other; Gray=Other ret_type



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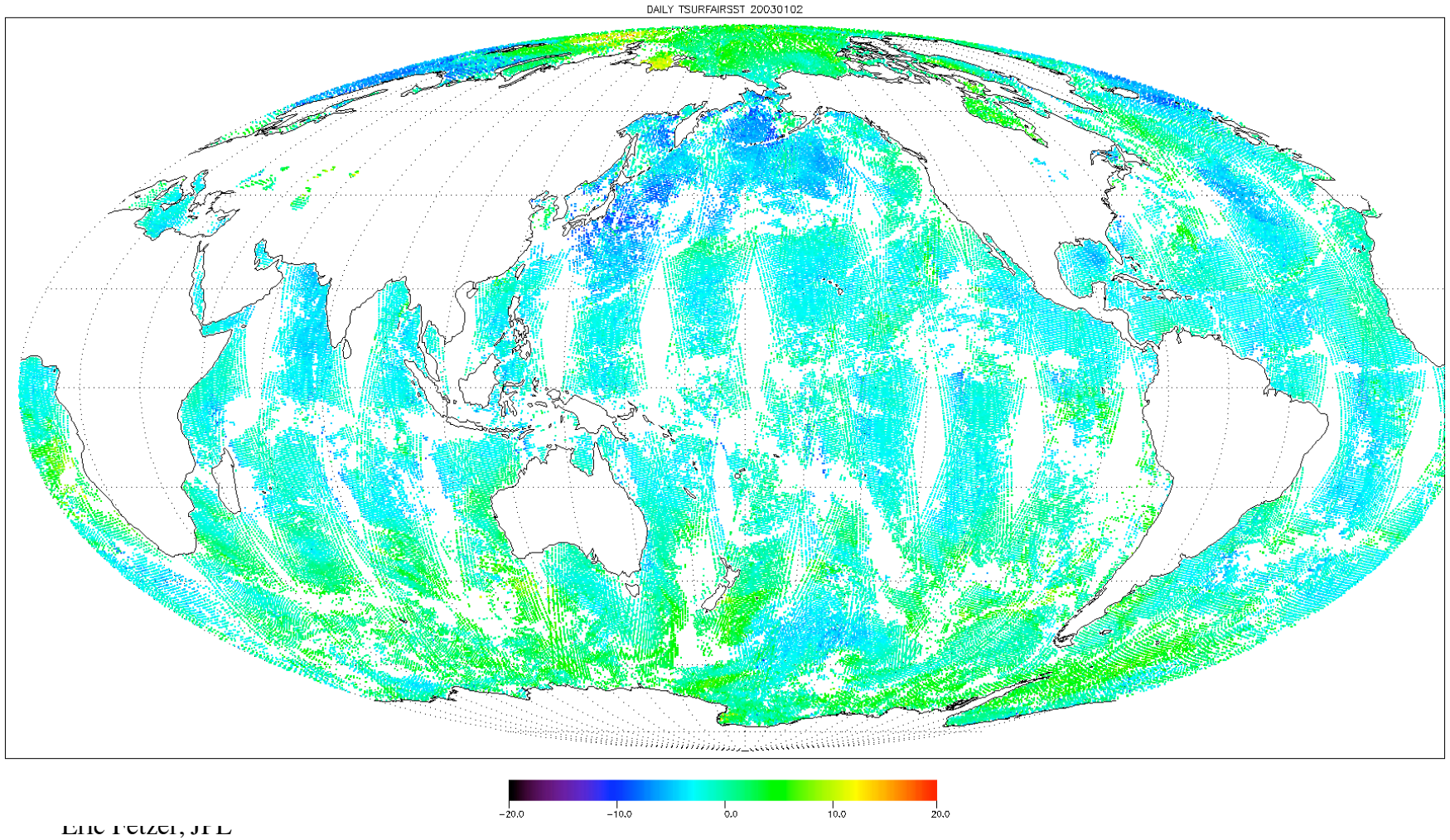
High Lapse Rates Correlate with TAirSurf-SSt<<0

Also 2 January; Note very low values east of Japan.



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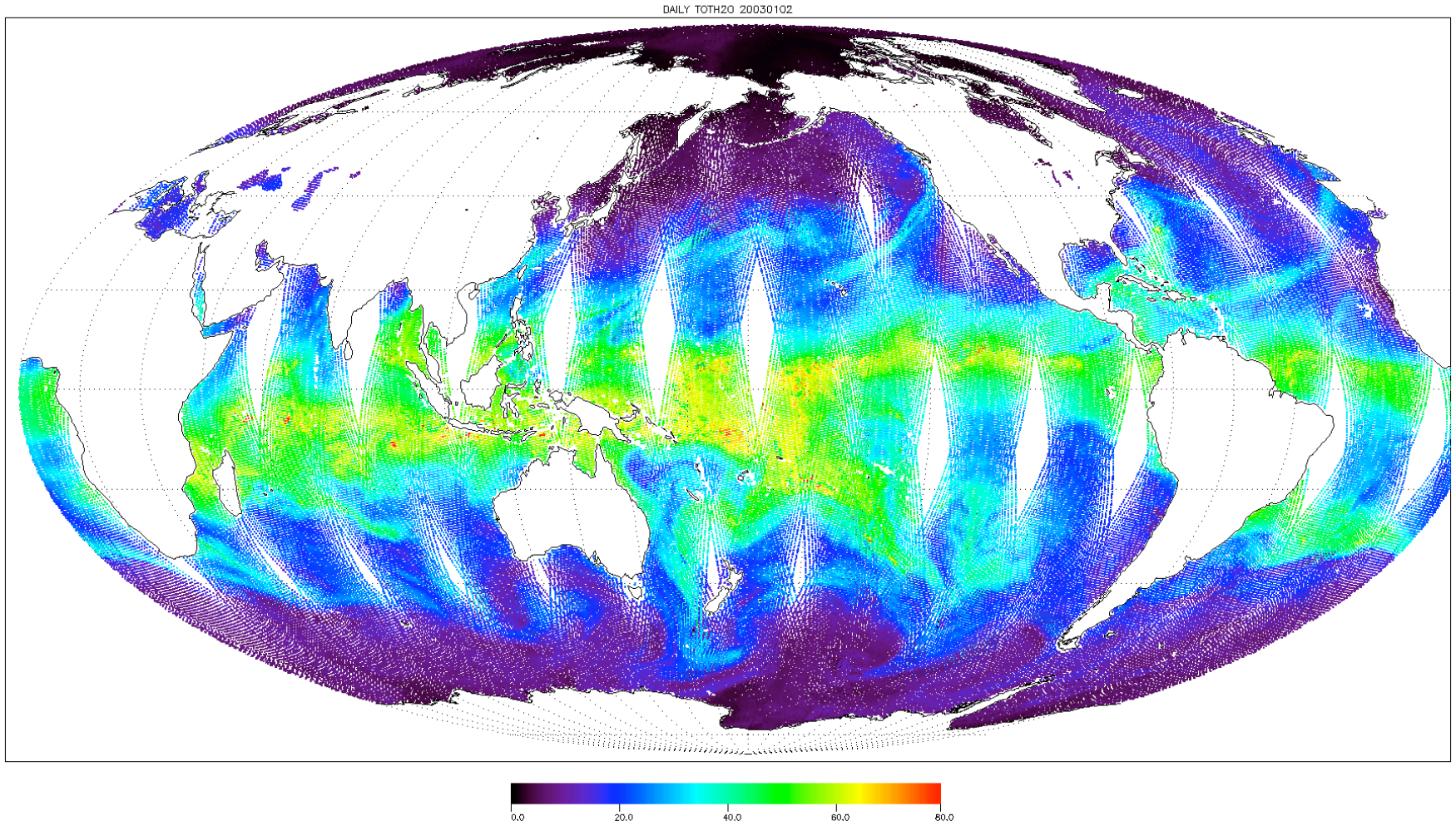
Cold Air Events are Anticorrelated with TotH2O

ALL RETRIEVAL TYPES, 2 Jan; Note low values off Japan



Conclusions about Superadiabatic Profiles and Associated Analyses

- Predominantly warm oceans under cold, descending air.
  - NOT a retrieval anomaly, according to ECMWF model.

- These fit into the bigger picture of cold air outbreaks and baroclinic waves moving across oceans.

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Conclusions about Exploratory Analyses of AIRS Retrievals

- Inversions and superadiabatic lapse rates are boundary layer phenomena
  - Important implications about AIRS retrieval information content

- LOTS of interesting information in AIRS retrievals yet to be discovered. Next steps:
  - Confidence in T => look at q and clouds
  - Calculate other global stats and see where these lead
    - *Global gradients and stability criteria*
  - *Quantify some of the relationships we see between variables.*

ALL THE HARD WORK IS PAYING OFF.
THIS IS A VERY IMPRESSIVE DATA SET!!!